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Electronic Still Camera

BACKGROUND OF THE INVENTIONField of the Invention

5 The present invention relates to an electronic still camera capable of storing photographed still image signal in a memory medium.

Related Background Art

10 In the conventional electronic still camera utilizing a memory medium, the storage of still image signal has been conducted with compression of said still image signal for example to about 1/10 by a suitable compression process, because the data amount of digitized still image signal is very large.

15 Also the conventional electronic still camera has only indicated the number of recorded frames, or only the remaining number of still recordable frames, by determining the data amount to be recorded in the memory medium per frame and equally dividing the total
20 capacity of the memory medium by said data amount.

SUMMARY OF THE INVENTION

 However, such data compression does not necessarily give a constant data amount after com-
25 pression, and, depending on the process of compression, the data amount after compression may fluctuate by about ± 50 % between a monotonous image and a complex

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1 image with fine definition. More specifically, if the
data amount after compression per phototaking operation
is 0.1 MB in average with a fluctuation of $\pm 50\%$
depending on the pattern of the image, said data amount
5 will vary from 0.05 to 0.2 MB. In such case, if only
the number of recorded frames is indicated, the total
number of frames recordable in the memory medium
varies from medium to medium, so that the photographer
is unable to know the total number of frames recordable
10 in the memory medium. A similar drawback occurs in case
of using a memory medium of different total capacity.
On the other hand, if indication of only the remaining
number of recordable frames is intended without
determination of data amount per frame to be recorded
15 in the memory medium, an exact remaining number cannot
be indicated because the data amount fluctuates from
frame to frame. An object of the present invention,
therefore, is to resolve the above-mentioned drawback
in the conventional indication system and to securely
20 inform the photographer of the remaining state of the
memory medium after a phototaking operation, by
simultaneously indicating the number of already taken
frames and the number of still recordable frames or
remaining capacity.

25 Also when the capacity allocation per frame is
fixed in the memory medium, all the taken information
cannot be recorded if the data amount after compression

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1 is larger than said allocated capacity, and the
capacity of the memory medium cannot be fully utilized
if the data amount after compression is smaller than
said allocated capacity. It is therefore more
5 efficient to record the compressed data for each
phototaking operation, without determining the
allocated capacity per frame. For this reason the
indication of the remaining recordable frames has to be
of a higher reliability. Another object of the present
10 invention, therefore, is to resolve the above-mentioned
drawback of the conventional indication system and to
provide an indication of remaining number of recordable
frames with higher reliability, by means of calculation
means.

15 The above-mentioned objects can be attained,
according to the present invention, by an electronic
still camera capable of A/D conversion of still image
signal obtained from an image pickup device and com-
pression of thus digitized signal, and provided with
20 a memory medium capable of recording thus compressed
signal plural times, comprising detection means for
detecting the remaining capacity of said memory medium,
memory means for memorizing the amount of said com-
pressed signal for each phototaking operation,
25 calculation means for determining the remaining number
of still recordable frames by dividing the remaining
capacity of the memory medium with amount of compressed

1 signal corresponding to a frame, and display means for
indicating the number of already recorded image frames
and said remaining number of recordable images.

5 The present invention also provides an electronic
still camera capable of A/D conversion of still image
signal obtained from an image pickup device and com-
pression of thus digitized signal, and provided with a
memory medium capable of recording thus compressed
10 signal plural times, comprising detection means for
detecting the remaining capacity of said memory medium,
memory means for memorizing the amount of said compressed
signal for each phototaking operation, calculation
means for determining the remaining number of still
recordable frames by dividing the remaining capacity of
15 the memory medium with amount of compressed signal
corresponding to a frame, and display switching means
capable of selecting either the indication of said
remaining number of still recordable frames or the indi-
cation of the remaining capacity of said memory medium.

20 The present invention also provides an
electronic still camera capable of A/D conversion of
still image signal obtained from an image pickup
device and compression of thus digitized signal, and
provided with a memory medium capable of recording
25 thus compressed signal plural times, comprising
detection means for detecting the remaining capacity
of said memory medium, memory means for memorizing the

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1 amount of said compressed signal for each phototaking
operation, calculation means for determining the
remaining number of still recordable frames by
dividing the remaining capacity of the memory medium
5 with amount of compressed signal corresponding to a
frame, and display means including a first display
part for indicating the number of already recorded
frames and a second display part of belt form
surrounding said first display part, wherein a range
10 of said second display part corresponding to said
remaining number of recordable frames is lighted,
whereby the number of already recorded frames and the
remaining number of recordable frames are indicated.

The present invention also provides an
15 electronic still camera capable of A/D conversion of
still image signal obtained from an image pickup
device and compression of thus digitized signal, and
provided with a memory medium capable of recording
thus compressed signal plural times, comprising
20 detection means for detecting the remaining capacity
of said memory medium, memory means for memorizing the
amount of said compressed signal for each phototaking
operation, extraction means for extracting the amount
of compression signal of latest frames of a predeter-
25 mined number from said memory means, calculation means
for determining the average amount of signal in the
frames of said predetermined number and determining

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1 the remaining number of recordable frames by dividing
the remaining capacity of the memory medium with said
average signal amount or with said average signal
amount increased by a predetermined proportion, and
5 display means for indicating said remaining number of
recordable frames.

The present invention also provides an electronic still camera capable of A/D conversion of still image signal obtained from an image pickup device and compression of thus digitized signal, and provided with a memory medium capable of recording thus compressed signal plural times, comprising detection means for detecting the remaining capacity of said memory medium, memory means for memorizing the amount of said compressed signal for each photo-taking operation, extraction means for extracting, from the memory means, the amount of compressed signal of frames recorded in said memory medium, calculation means for determining the average signal amount per frame on thus extracted frames and determining the remaining number of recordable frames by dividing the remaining capacity of the recording medium with said average signal amount or with said average signal amount increased by a predetermined proportion, and display means for indicating said remaining number of recordable frames.

The present invention also provides an

1 electronic still camera capable of A/D conversion of
still image signal obtained from an image pickup device
and compression of thus digitized signal, and provided
with a memory medium capable of recording thus
5 compressed signal plural times, comprising detection
means for detecting the remaining capacity of said
memory medium, memory means for memorizing the amount
of said compressed signal for each phototaking operation,
10 extraction means for extracting the maximum
amount of latest compression signals from said memory
means, calculation means for determining the remaining
number of recordable frames by dividing the remaining
capacity of the memory medium with said maximum signal
amount, and display means for indicating said remaining
15 number of recordable frames.

The present invention also provides an
electronic still camera capable of A/D conversion of
still image signal obtained from an image pickup
device and compression of thus digitized signal, and
20 provided with a memory medium capable of recording
thus compressed signal plural times, comprising
detection means for detecting the remaining capacity
of said memory medium, calculation means for determining
the remaining number of recordable frames by dividing
25 the remaining capacity of the memory means with a
predetermined amount, and display means for indicating
said remaining number of recordable frames.

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1 The present invention also provides an
electronic still camera capable of A/D conversion of
still image signal obtained from an image pickup
device and compression of thus digitized signal, and
5 provided with a memory medium capable of recording
thus compressed signal plural times, comprising
detection means for detecting the remaining capacity
of said memory medium, memory means for memorizing
the amount of said compressed signal for each photo-
10 taking operation, calculation means for determining
the remaining number of recordable frames by dividing
the remaining capacity of the memory medium with the
amount of said compressed signal in a latest photo-
taking operation, and display means for indicating
15 said remaining number of recordable frames.

 The present invention also provides an
electronic still camera capable of A/D conversion of
still image signal obtained from an image pickup
device and compression of thus digitized signal, and
20 provided with a memory medium capable of recording thus
compressed signal plural times, comprising detection
means for detecting the remaining capacity of said
memory medium, memory means for memorizing the amount
of said compressed signal for each phototaking ope-
25 ration, extraction means for extracting the maximum
and minimum amounts of the compressed signals from
said memory means calculation means for determining

1 minimum and maximum remaining numbers of recordable
frames by dividing the remaining capacity of the
recording medium respectively with said maximum and
minimum signal amounts, and display means for
5 indicating said remaining number of recordable frames
by a range of which minimum and maximum values
respectively correspond to said minimum and maximum
remaining number of recordable frames.

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The present invention also provides an

10 electronic still camera capable of A/D conversion of
still image signal obtained from an image pickup
device and compression of thus digitized signal, and
provided with a memory medium capable of recording
thus compressed signal plural times, comprising
15 detection means for detecting the remaining capacity
of said memory medium, memory means for memorizing
the amount of said compressed signal for each photo-
taking operation, extraction means for extracting the
maximum amount, minimum amount and approximate
20 average amount of the compressed signals from said
memory means, calculation means for dividing the
remaining capacity of the memory medium with said
maximum or minimum amount or said approximate
average amount thereby determining a respectively
25 corresponding remaining number of recordable frames,
selection means for manually selecting said maximum,
minimum or approximate average amount of the

1 compressed signal, and display means for indicating
said selected minimum, maximum or approximate average
amount of the compressed signal and the remaining
number of recordable frames corresponding to thus
5 selected compressed signal.

The present invention also provides an electronic still camera capable of A/D conversion of still image signal obtained from an image pickup device and compression of thus digitized signal, and provided with a memory medium capable of recording thus compressed signal plural times, comprising detection means for detecting the remaining capacity of said memory medium, memory means for memorizing the amount of said compressed signal for each photo-taking operation, extraction means for extracting the amount of compression signal of latest frames of a predetermined number from said memory means, calculation means for calculating the average signal amount of frames of said predetermined number and the standard deviation of said signal amount, and determining the minimum remaining number of recordable frames by dividing the remaining capacity of the memory medium with the sum of said average amount and said standard deviation increased by a predetermined proportion and the maximum remaining number of recordable frames by dividing the remaining capacity of the memory medium with said average amount from

1 which subtracted is said standard deviation increased
by a predetermined proportion, and display means for
indicating said remaining numbers of recordable
frames.

5 The present invention also provides an
electronic still camera capable of A/D conversion
of still image signal obtained from an image pickup
device and compression of thus digitized signal,
and provided with a memory medium capable of recording
10 thus compressed signal plural times, comprising
detection means for detecting the remaining capacity
of said memory medium, memory means for memorizing
the amount of said compressed signal for each photo-
taking operation, start signal input means for
15 manually entering an average calculation start signal,
extraction means for extracting, from said memory
means, the amount of compressed signal of the frames
after the entry of the calculation start signal by
said input means, calculation means for calculating
20 the average signal amount of said frames and
determining the remaining number of recordable frames
by dividing the remaining capacity of the memory medium
with said average signal amount, and display means
for indicating said remaining number of recordable
25 frames.

 The present invention also provides an
electronic still camera capable of A/D conversion of

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1 still image signal obtained from an image pickup
device and compression of thus digitized signal, and
provided with a memory medium capable of recording
thus compressed signal plural times, comprising
5 detection means for detecting the remaining capacity
of said memory medium, memory means for memorizing the
amount of said compressed signal for each phototaking
operation, start signal input means for manually
entering an average calculation start signal, ex-
10 traction means for extracting, from said memory means,
the amount of compressed signal of the frames after
the entry of the calculation start signal by said
input means, calculation means for calculating the
average signal amount of said frames and the standard
15 deviation thereof, and determining the minimum
remaining number of recordable frames by dividing the
remaining capacity of the memory medium with said
average signal amount to which added is said standard
deviation increased by a predetermined proportion,
20 and the maximum remaining number of recordable frames
by dividing the remaining capacity of the memory
medium with said average signal amount from which
subtracted is said standard deviation increased by a
predetermined proportion, and display means for
25 indicating said remaining numbers of recordable frames.

The present invention also provides an
electronic still camera capable of A/D conversion of

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- 1 still image signal obtained from an image pickup
device and compression of thus digitized signal, and
provided with a memory medium capable of recording
thus compressed signal plural times, comprising
 - 5 detection means for detecting the remaining capacity
of said memory medium, memory means for memorizing
the amount of said compressed signal for each photo-
taking operation, calculation means for determining the
remaining number of recordable frames by dividing the
 - 10 remaining capacity of the memory medium with a pre-
determined signal amount until a predetermined number
of frames, and, beyond said number, calculating the
average signal amount of the frames recorded in said
memory medium and the standard deviation thereof and
 - 15 determining the minimum remaining number of recordable
frames by dividing the remaining capacity of the
recording medium with said average signal amount to
which added is said standard deviation increased by
a predetermined proportion and the maximum remaining
 - 20 number of recordable frames by dividing the remaining
capacity of the recording medium with said average
signal amount from which subtracted is said standard
deviation increased by a predetermined proportion,
and display means for indicating said remaining
 - 25 number(s) of recordable frames.

The present invention also provides an
electronic still camera capable of A/D conversion of

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1 still image signal obtained from an image pickup
device and compression of thus digitized signal, and
provided with a memory medium capable of recording
thus compressed signal plural times, comprising
5 compression rate selection means for selecting one of
plural compression rates with which said digitized
signal is compressed, detection means for detecting
the remaining capacity of said memory medium, memory
means for memorizing the amount of said compressed
10 signal and the compression rate for each phototaking
operation, extraction means for extracting the
maximum and minimum amounts of the compressed
signal for each compression rate from said memory
means, calculation means for determining the minimum
15 and maximum remaining numbers of recordable frames for
each compression rate by dividing the remaining
capacity of the memory medium respectively with said
maximum and minimum signal amounts, and display means
for indicating the remaining number of recordable
20 frames by a range of which minimum and maximum values
correspond to those of said remaining number of
recordable frames in the currently selected compression
rate.

The present invention also provides an
25 electronic still camera capable of A/D conversion of
still image signal obtained from an image pickup
device and compression of thus digitized signal, and

1 provided with a memory medium capable of recording
thus compressed signal plural times, comprising
compression rate selection means for selecting one of
plural compression rates with which said digitized
5 signal is compressed, detection means for detecting
the remaining capacity of said memory medium, memory
means for memorizing the amount of said compressed
signal and the compression rate for each phototaking
operation, extraction means for extracting, from said
10 memory means, the maximum and minimum amounts of
latest compression signals for each compression rate,
calculation means for determining the minimum and
maximum remaining numbers of recordable frames for
each compression rate by dividing the remaining
15 capacity of the memory medium respectively with the
maximum and minimum signal amounts, and display
means for indicating the minimum and maximum remaining
numbers of recordable frames of the currently selected
compression rate.

20 As described above, the present invention
allows to correctly inform the photographer of the
status of use of the memory medium, even in case of
fluctuation of the data amount after compression
because of the pattern of the frames, as the number of
25 recorded image frames and the remaining number of
recordable image frames are displayed at the same time.

Also the present invention enables to indicate

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1 the remaining number of recordable image frames to
the photographer in an easily understandable visual
manner.

Also the present invention is capable of
5 indicating the highly reliable remaining number of
recordable image frames.

Naturally, the number of recorded image frames
and the remaining number of still recordable image
frames need not necessarily be always displayed together,
10 but either one only may be indicated depending upon the
case.

Also the present invention allows the photo-
grapher to know the remaining state of the memory
medium after a phototaking operation.

15 Also the present invention is capable of
informing the photographer of the remaining number of
recordable image images in the memory medium, after a
phototaking operation, in the form of a range from a
minimum number to a maximum number.

20 Also the present invention enables the photo-
grapher to observe selectively the images with minimum,
maximum and approximately average amounts of compressed
data, among image frames recorded by photographer
himself, and is capable of informing the remaining
25 number of recordable image frames in the memory medium
after a phototaking operation, based on the selected
image.

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1 Also the present invention is capable of informing the photographer with the remaining number of recordable image frames with a safety margin.

 Also the present invention is capable of
5 informing the photographer of the remaining number of recordable image frames in the memory medium, in case the purpose or intention of the photographer changes.

 Also the present invention is capable of
 informing the photographer of the remaining status of
10 the memory medium after a phototaking operation, thereby enabling the photographer to effect phototaking operations adapting to said remaining status.

BRIEF DESCRIPTION OF THE DRAWINGS

15 Fig. 1 is an external view of an electronic still camera;

 Fig. 2 is a block diagram thereof;

 Fig. 3 is a flow chart of a control sequence by a CPU 20;

20 Figs. 4 to 6 are flow charts of a subroutine in a step S10 in Fig. 3, constituting 1st to 3rd embodiments of the present invention;

 Fig. 7 is a schematic view showing, as a 6th embodiment, the method of display of a display unit
25 14 shown in Fig. 1;

 Fig. 8 is a schematic view showing, as a 7th embodiment, the method of display in a view finder 19

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1 shown in Fig. 1;

Figs. 9A and 9B are schematic views showing as an 8th embodiment, another method of display of the display unit 14 shown in Fig. 1;

5 Fig. 10 is a schematic view showing, as a 9th embodiment, the method of display in a display unit 14 shown in Fig. 1;

Fig. 11 is an external view showing, as a 10th embodiment, an electronic still camera;

10 Fig. 12 is a block diagram of the electronic still camera shown in Fig. 11;

Figs. 13 to 15 are flow charts of the control sequence by a CPU 211;

15 Figs. 16 to 21 are flow charts, showing, as 11th to 16th embodiments, control sequences for calculating the remaining number of recordable frames; and

20 Figs. 22 to 24 are schematic views showing, as 17th to 18th embodiments, methods of display in a display unit 115 shown in Fig. 11.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now the present invention will be clarified in detail by preferred embodiments thereof shown in the
25 attached drawings.

Fig. 1 is an external view of an electronic still camera of the present invention.

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1 Referring to Fig. 1, a main body of the
electronic still camera is provided with a slot 13
into which inserted is a memory card 12 constituting
the memory medium for storing image data supplied
5 from the main body. A display unit 14 provided on the
rear face of the main body 11 displays the number
of already recorded frames and the remaining number of
still recordable frames or the remaining capacity.
The method of determining the displayed remaining
10 number will be detailedly explained later. Another
liquid crystal display unit 15 is used for displaying
the contents of the memory card 12 or as an electronic
view finder. The exposure operation of the camera is
initiated by a shutter release button 16. A mode
15 setting dial 17 is usually used for setting a shutter
time or an aperture of the diaphragm of the photo-
taking lens, but can also be used for switching the
displayed content of the display unit 15, when
rotated while a selector button 18 is depressed. Also
20 an optical view finder 19 is provided in the upper
part of the main body.

The number of recorded frames and the remaining
number of recordable frames may also be displayed on
the display unit 15 in overlapping manner with the
25 image displayed therein, instead of display in the
display unit 14.

Also the display unit 15 may be used normally

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5 Fig. 2 is a block diagram of the present
electronic still camera, provided with a CPU 21, an
A/D converter 22, a compression unit 23, a memory card
12, a display unit 14, a recorded frame number counter
24, an image pickup unit 25, and a buffer memory 26.

At first, when the power supply is turned on, a step S10 displays the number of recorded image frames and the remaining number still recordable image frames, on the display unit. The method for determining said displayed remaining number will be explained later.

In a step S12, the A/D converter 22 digitizes the still image signal obtained by said exposure.

25 Then a step S14 accumulates the compressed
data in the buffer memory 26 and memorizes the amount
of said compressed data.

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15

20

25

1 average value.

In the following the flow chart of the present subroutine will be explained step by step.

5 A step S20 discriminates whether the number of image frames already recorded by the present still camera is at least equal to 100. This is because the average calculation utilizes 100 frames, but the number of frames is not limited to 100 and can be arbitrarily selected as a number at least equal to 2. The sequence
10 proceeds to a step S21 or S25 respectively if said number is at least equal to 100 or less than 100.

Then a step S21 extracts the amount of compressed data, for the latest 100 frames, already accumulated in the step S14 in Fig. 3.

15 A next step S22 calculates the average value, from thus extracted amount of compressed data of 100 frames.

A next step S23 increases the calculated average by 30 %. This is to provide a certain safety
20 margin, by displaying a smaller remaining number of recordable image frames, rather than giving an erroneous expectation to the photographer by displaying a larger number, and the amount of said increase is not limited to 30 %.

25 A next step S24 calculates the estimated remaining number of recordable frames by dividing the remaining capacity of the memory card with said

1 increased average value. Subsequently the sequence
proceeds to a step S26.

On the other hand, in case the number of
recorded frames is less than 100, a step S25 calculates
5 a value, as the substitute for the estimated remaining
number of recordable frames, by dividing the remaining
capacity of the memory card with a predetermined
maximum amount of compressed data (0.2 MB explained in
the Related Background Art), and the sequence then
10 proceeds to the step S26.

The step S26 discards the fractional part of
the value calculated in the step S24 or S25, in order
to obtain an integral number for display. Said dis-
carding operation is also for giving a safety margin
15 to the displayed number, and may be replaced by a
rounding operation.

A next step S27 displays, on the display unit
14, thus obtained integral value as the estimated
remaining number of recordable image frames for the
20 individual photographer, and the present subroutine is
then terminated.

Fig. 5 is a flow chart of a 2nd embodiment of
the control sequence for determining the remaining
number of recordable frames, in the step S10 in Fig. 1.

25 This embodiment is based on a fact that
similar objects are often recorded in consecutive
manner, and consists of calculating the average of

1 compressed data amount from all the data recorded in
the memory card currently in use, then increasing said
average by 30 % as in the 1st embodiment, and displaying
the integral value, obtained by dividing the remaining
5 capacity with said increased average, as the estimated
remaining number of recordable frames for the current
memory card.

The flow chart of the present subroutine will
be explained in the following, step by step.

10 At first a step S30 discriminates whether the
next phototaking operation is for the first frame in
the currently used memory card. This is because said
average calculation employs at least one frame. If
there are employed at least two frames, said step
15 discriminates whether the next phototaking operation
is for the second frame. Then the sequence proceeds
to a step S31 or S35, respectively if the next photo-
taking operation is at least for the 2nd frame, or for
the 1st frame.

20 Then a step S31 extracts the amount of com-
pressed data, for all the frames stored in the memory
card, accumulated by the step S14 in Fig. 3, and a
step S32 calculates the average from thus extracted
compressed data amount of all the frames.

25 A next step S33 increases the calculated
average by 30 %, for the same reason as in the 1st
embodiment.

1 A next step S34 calculates the estimated
remaining number of recordable image frames, by
dividing the remaining capacity of the memory card
with said increased average, and the sequence then
5 proceeds to a step S36.

 On the other hand, in case there is no
recorded frame and the next phototaking operation is
for the first frame, a step S35 calculates a value,
as a substitute for the estimated remaining number of
10 recordable frames, by dividing the remaining capacity
of the memory card with a predetermined maximum amount
of compressed data (0.2 MB explained before).

 A next step S36 discards the fractional part
of the value calculated in the step S34 or S35, in
15 order to obtain an integral value for display, as in
the 1st embodiment.

 A next step S37 displays, on the display unit
14, thus obtained integral value as the estimated
remaining number of recordable image frames for the
20 current memory card, and the present subroutine is
then terminated.

 Fig. 6 is a flow chart of a 3rd embodiment of
the subroutine for determining the remaining number of
recordable frames, in the step S10 in Fig. 3.

25 The present embodiment adopts the estimated
minimum value as the remaining number of recordable
frames, for giving emphasis on the safety margin, and

The flow chart of the present subroutine will be explained in the following, step by step.

A next step S41 calculates a value by dividing the remaining capacity of the memory card with thus extracted maximum amount of compressed data.

A next step S43 displays, on the display unit 14, thus obtained integral value as the minimum remaining number of recordable frames, and the present subroutine is then terminated.

A 4th embodiment of the control sequence for determining the remaining frame number in the step S10 in Fig. 3, displays the remaining capacity of the memory card 12 in the unit of MB. The corresponding flow chart of this embodiment is not shown in the attached drawings.

1 A 5th embodiment of the control sequence for
determining the remaining frame number in the step
S10 in Fig. 3 consists of dividing the remaining
capacity with a predetermined minimum compressed data
5 amount (0.05 MB explained before) and displaying an
integer, obtained by raising the fractional part, as
the maximum remaining number of recordable frames.

 The display on the display unit 14 can be
made with one of the foregoing 1st to 5th embodiments,
10 or can also be made selectable from two or more
determining sequences.

 Fig. 7 illustrates, as a 6th embodiment, a
display method of the display unit 14 shown in Fig. 1.
Fig. 7 shows an arrangement including paired seven-
15 segment elements 32 for indicating the number of
already recorded frames in a two-digit number; a symbol
mark 31 to be turned on for indicating that the seven-
segment elements 32 indicate the number of recorded
frames; paired seven-segment elements 34 for indicating
20 the remaining number of recordable frames in a two-
digit number; and a symbol mark 33 to be turned on for
indicating that the seven-segment elements 34 indicate
the remaining number of recordable frames. Said
remaining number in this embodiment is determined
25 according to the 1st embodiment explained above.

 Fig. 8 illustrates, as a 7th embodiment, a
method of displaying the number of recorded frames and

Under an image field frame 41, there are arranged, from left to right, a mode display unit 42 for indicating the phototaking mode of the still camera such as P (program mode), A (aperture preferential mode), S (shutter speed preferential mode) etc.; a diaphragm aperture display unit 43; and a shutter time display unit 44. In succession there are provided paired seven-segment elements 46 for indicating the number of recorded frames in a two-digit number; a symbol mark 45 to be lighted for indicating that the seven-segment elements 46 indicate the number of recorded frames; paired seven-segment elements 48 for indicating the remaining number of recordable frames in a two-digit number; and a symbol mark 47 to be lighted for indicating that the seven-segment elements 48 indicate the remaining number of recordable frames. Fig. 8 illustrates a case with a program phototaking mode, a diaphragm aperture of F5.6, a shutter time of 1/250 seconds, 13 recorded frames and 14 frames still recordable. The remaining number of recordable frames is determined according to the foregoing 2nd embodiment.

Figs. 9A and 9B illustrate, as an 8th embodiment, a display method in the display unit 14 shown

1 in Fig. 1.

This embodiment can switch the display of the remaining state of the memory card 12 either in (A) remaining capacity, or (B) remaining number of recordable frames, according to the selection by the photographer.

Figs. 9A and 9B show an arrangement of paired seven-segment elements 52 for indicating the number of recorded frames in a two-digit number, illustrating a case of 14 recorded frames; a symbol mark to be lighted for indicating that the seven-segment elements 52 indicate the number of recorded frames; paired seven-segment elements 55 for indicating the remaining number of recordable frames or the remaining recordable capacity in a two-digit number; a symbol mark 53 to be lighted in case said elements 55 indicate the remaining frame number; a symbol mark 54 to be lighted in case said elements 55 indicate the remaining recordable capacity; and a symbol mark 56 for indicating the unit of said capacity, to be lighted simultaneously with the symbol mark 54. The display of the remaining frame number or the remaining capacity is switched by the rotation of the setting dial 17, with depression of the selector button 18.

Fig. 9A shows a state indicating that the remaining recordable capacity is 2.7 MB, by the marks 54, 56 and the elements 55.

1 Fig. 9B shows a state indicating that 13 frames
are remaining, by the mark 53 and the elements 55.

 In the present embodiment, the remaining
recordable capacity is determined according to the
5 foregoing 4th embodiment, and the remaining number of
recordable frames is determined according to the
foregoing 3rd embodiment.

 Also there may be additionally selected the
display of number of recorded frames only, or of
10 remaining frame number or remaining capacity only, by
the rotation of the setting dial 17.

 Fig. 10 illustrates, as a 9th embodiment, a
display method of the display unit 14 shown in Fig. 1.

 There are provided paired seven-segment
15 elements 61 for indicating the number of recorded
frames in a two-digit number, and single-segment
elements 62a, 62b serving to indicate the remaining
number of recordable frames and so positioned as to
surround said seven-segment elements 61. A single-
20 segment portion 62a corresponding to the remaining
number is lighted, while the remaining portion 62b is
turned off. For each phototaking operation, the
number of the seven-segment elements 61, indicating
the number of recorded frames, is stepwise increased
25 by one, while the single segments 62b, positioned
therearound and indicating the remaining frame number,
are in succession turned off anticlockwise. In this

In the following there will be given a detailed explanation on a 10th embodiment of the electronic still camera of the present invention.

A display unit 115 composed for example of
15 a liquid crystal display device and positioned on the
rear face of the main body 11 of the camera is used
for indicating the contents of the memory card 12 or
as an electronic view finder. Also on said rear face
provided is an up-down button 120 to be used in
20 reproducing of the image of the memory card 12 on the
display unit 115 or searching the image of said memory
card 12.

The display on the display unit 115 can provide, for example, a reproduction mode for displaying designated one among the still images recorded in the memory card 12 and a moving image mode for displaying a moving image as the electronic view finder, said

1 modes being selectable by the rotation of the setting
dial 17 with the depression of the selector button 18.

Fig. 12 is a block diagram of the present still camera, wherein solid-lined arrows indicate the flow of image signal, and broken lines indicate the transmission paths of control signals of a CPU 211.

An analog image signal, generated by an image pickup unit 201 composed for example of a phototaking lens, a diaphragm, a shutter, a CCD, a signal processing circuit etc., is converted by an A/D converter 202 into a digital signal, which is recorded through a selector switch 203 in a buffer memory 204. Beyond said buffer memory 204, the flow of the image signal is branched into two paths. In one of said two paths, the image signal is guided through a compression circuit 205 and an interface circuit 206 and stored in the memory card 12. In the other path, the image signal is guided through a D/A converter 208, a selector switch 209 and adding circuit 210 and displayed on an LCD monitor 115. Also the compressed image signal in the memory card 12 is supplied through the interface circuit 206, expanded in an expanding circuit 207, further guided through the selector switch 203, D/A converter 208, selector switch 209 and adding circuit 210 and displayed on the LCD monitor 115.

The LCD monitor 115 also displays characters and symbols generated in the CPU 211 in overlapping

1 with the image signal, by means of the adding circuit
210. This overlapping display will be explained later.

Said characters and symbols can also be displayed on the display unit 14.

5 In case the LCD monitor 115 is used as an
electronic view finder, the image signal from the
image pickup unit 201 is supplied thereto through the
selector switch 209 and adding circuit 210.

The CPU 211 also receives various manual input signals from an operation unit 212 including the shutter release button 16, setting dial 17, selector button 18, up-down button 120 etc. The CPU 211 is equipped with a timer for measuring, after a manual input operation, the time for enabling a next manual operation. Controls signals of the CPU 211, generated in response to various manual input signals from said operation unit 212, control the functions of the image pickup unit 201, A/D converter 202, selector switch 203, buffer memory 204, compression circuit 205, interface circuit 206, expansion circuit 207, D/A converter 208, selector switch 209, adding circuit 210, LCD monitor 115, memory card 12 and display unit 14.

In the following there will be explained the writing of image signal into the memory card 12 and reading of image signal therefrom, and the image display on the display unit 115 under the control of the CPU 211, with reference to a flow chart shown in Fig. 13.

1 A step S306 reads the expanded image data from
the buffer memory 204, then a step S307 effects D/A
conversion, and a step S308 displays the reproduced
still image on the LCD monitor 115 through the selector
5 switch 209 and the adding circuit 210.

 Thereafter the sequence returns to the step
S301 and continues the reproduction of the image,
selected by the up-down button 120, on the LCD monitor
115, unless the power supply is turned off in a step
10 S309.

 On the other hand, if the step S301 identifies
that the moving image mode is selected for the display,
the sequence proceeds to a step S310.

 The step S310 discriminates whether a timer 213
15 is in function. If a predetermined time of the timer
213 expires without any actuation of the shutter
release button 16, no display is conducted on the LCD
monitor 115, and the sequence proceeds to a step S311.

 The sequence passes through said step S311,
20 since there is no display in this state, and proceeds
to the aforementioned step S309.

 On the other hand, if said step S310 identifies
that the timer is in function, the sequence proceeds
to a step S312.

25 The step S312 discriminates whether the shutter
release button 16 is depressed by a half stroke, and,
if depressed, the sequence proceeds to a next step

1 signal in the buffer memory 204, and a step S319 reads
the image signal recorded in the step S319 in the
buffer memory 204.

5 Thereafter the image signal flows along two
paths. In one path, the image signal is displayed on
the LCD monitor 115 in steps S320 - S321. In the
other, the image signal is stored in the memory card
in steps S322 - S323.

10 In the display path, a step S320 effects D/A
conversion on the image stored in the buffer memory
204, and a step S321 displays the image what has just
been taken as a still image on the LCD monitor 115,
through the selector switch 209 and the adding circuit
210. The duration of display of said still image need
15 only to be enough for allowing the photographer to
confirm the recorded image, in consideration of the
case of continuous phototaking operations.

In the other recording path, a step S322
compresses the image signal, read in the step S319
20 from the buffer memory 204, and a step S323 stores
thus compressed image signal into the memory card 12.

After said recording, and after the completion
of display of still image on the LCD monitor 115, the
sequence proceeds to a step S324.

25 The step S324 causes the LCD monitor 115 to
function as an electronic view finder for displaying a
moving image. Then the sequence returns to the step

1 may be displayed a message that the display is the
 phototaken image, warning for failed phototaking,
 warning for insufficient capacity of memory card,
 message indicating the completion of recording in the
 memory card.
 5

Among these, the display of the remaining number of recordable frames will be explained in the following, with reference to Figs. 14 and 15.

At first reference is made to Fig. 14 for explaining the flow of display of the remaining number of recordable frames. It is assumed that the present camera is capable of selecting one of two modes of different compression rates, namely a normal image quality mode for compressing the image to about 1/10, and a low image quality mode for compressing the image to about 1/20.

The control sequence of the flow chart shown in Fig. 14 is initiated in response to the half-stroke depression of the shutter release button 16.

At frist a step S401 sets initial values of the maximum and minimum data amounts in respective image quality modes in predetermined registers. Said initial values are the approximate average values and the anticipated values stored in advance in an EEPROM or the like at the manufacture of the camera. The initial values for the maximum and minimum data amounts in the normal and low image quality modes are represented

1 by MI, mI, MII and mII (suffixes I, II respectively
indicating the normal and low image quality modes, and
M, m standing respectively for the maximum and minimum
data amounts in each mode), and the initial value
5 setting registers are indicated by DMAX I, DMINI I,
DMAX II and DMINI II. Also a parenthesized register
name indicates the content thereof, for example (DMAX
I) = MI. Also there are provided registers DATAMAX
I, DATAMINI I, DATAMAX II and DATAMINI II for storing
10 renewal data at each phototaking operation, into
which the values of the initial value setting registers
are set in the step S401. Thus the operations in the
step S401 can be represented as follows:

(DMAX I) ← MI
15 (DMINI I) ← mI
(DMAX II) ← MII
(DMINI II) ← mII
(DATAMAX I) ← (DMAX I)
(DATAMINI I) ← (DMINI I)
20 (DATAMAX II) ← (DMAX II)
(DATAMINI II) ← (DMINI II)

After the initial settings in the step S401,
the sequence proceeds to a step S402.

The step S402 discriminates whether the memory
25 card 12 is present, and the sequence proceeds to a
step S403 or S405 respectively if the memory card 12 is
absent or present.

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A next step S404 discriminates whether the timer 213 is in function. During the function of the timer 213, the steps S402 to S404 are repeated, and, after the completion of function of the timer 213, the display for the absence of memory card, on the LCD monitor 115, is terminated.

The step S406 discriminates whether the selected image quality mode has been changed, and, if changed, the sequence returns to the step S405 thereby displaying the remaining frame number in the newly
20 selected image quality mode. If the mode has not been changed, the sequence proceeds to a step S407.

The step S407 discriminates whether the timer 213 is in function, and, if in function, the sequence proceeds to a step S408, but, if the timer function has been completed, the display of the remaining frame number on the LCD monitor 115 is terminated as in the step S404.

1 The step S408 discriminates whether the shutter
release button 16 has been depressed over a full stroke,
and, if depressed, the sequence proceeds to a next
step S409. Since the memory card 12 may be extracted
5 from the main body 11 during the function of the timer
and prior to the full-stroke depression of the shutter
release button 16, if the button 16 is not depressed,
the sequence returns to the step S402 for repeating
the steps S402 to S408.

10 In case the step S408 identifies the full-
stroke depression of the shutter release button 16,
a step S409 effects the exposure, A/D conversion,
data compression and data storage in the memory card
12, as already explained in the flow chart shown in
15 Fig. 13, and the sequence then proceeds to a step S410.

 The step S410 calculates or detects the maximum
or minimum data amount anew, and renews the settings
of the registers DATAMAX I etc. for the data requiring
renewal, and then the sequence returns to the step
20 S402 for repeating the above-explained sequence. The
operations in said step S410 will be explained more
detailedly later.

 In the following there will be explained the
method of determination of the remaining number of
25 recordable frames, for the display of said remaining
frame number in the step S405, with reference to a flow
chart shown in Fig. 15.

1 At first a step S501 discriminates whether
the image quality mode is the normal image quality
mode, and the sequence proceeds to a step S502 or
S504, respectively if the normal or low image quality
5 mode is selected.

 The step S502 sets the maximum and minimum
data amounts, respectively stored in the registers
DATAMAX I, DATAMINI I for the normal image quality
mode, respectively in other registers DATAMAX, DATAMINI.

10 A next step S503 sets the values of the initial
value setting registers DMAX I, DMINI I respectively
in other registers DMAX, DMINI, and the sequence
proceeds to a step S506.

 In case the step S501 identifies that the low
15 image quality mode is selected, a step S504 sets the
maximum and minimum data amounts, respectively stored
in the registers DATAMAX II, DATAMINI II for the low
image quality mode, respectively in other registers
DATAMAX, DATAMINI.

20 A next step S505 sets the values of the initial
value setting registers DMAX II, DMINI II respectively
in other registers DMAX, DMINI, and the sequence proceeds
to the step S506.

 The step S506 discriminates whether the value
25 of said DATAMAX is larger than that of DMAX, and, if
larger or otherwise, the sequence respectively proceeds
to a step S507 or S508.

1 The step S507 sets the value of the register
DATAMAX into the register DMAX, and the sequence
proceeds to the step S508.

5 The step S508 discriminates whether the value
of the register DATAMINI is smaller than that of the
register DMINI, and, if smaller or otherwise, the
sequence respectively proceeds to a step S509 or S510.

10 The step S509 sets the value of DATAMINI in the
register DMINI, and the sequence proceeds to the step
S510.

15 The step S510 calculates the minimum and
maximum remaining numbers of recordable frames, by
dividing the remaining capacity of the memory card 12
respectively with the values of DMAX and DMINI and
discarding the fractional part.

 A next step S511 displays the minimum and
maximum remaining numbers, determined in the step S510,
on the LCD monitor 115, and the present sequence is
thus terminated.

20 In the following there will be explained
the method of determining the maximum or minimum data
amount, in the step S410 in Fig. 14, with reference
to Figs. 16 to 21. The values obtained in this method
can be used as the values in the above-mentioned
25 registers DATAMAX I, DATAMINI I etc. In the following
there are explained plural calculating methods as
different embodiments, and the camera is preferably so

1 constructed as to be capable of selecting plural methods
according to the function of camera or the situation in
which the camera is used.

Fig. 16 is a flow chart showing, as an 11th
5 embodiment, a subroutine for determining the maximum
or minimum data amount.

This embodiment calculates, at each photo-
taking operation, the average data amount NA on latest
 N frames and the standard deviation $N\sigma$ thereof, and
10 uses $NA + N\sigma$ and $NA - N\sigma$ respectively as the maximum
and minimum data amounts.

In the following the sequence of this sub-
routine will be explained step by step.

At first a step S601 discriminates whether the
15 next phototaking operation is for the 1st frame in the
currently used memory card. This is because the
average calculation requires data of at least one frame.
The sequence then proceeds to a step S602 or S606,
respectively if the next phototaking operation is at
20 least for the 2nd frame, or for the 1st frame.

The step S602 extracts the amount of compressed
data of all the frames already recorded.

A next step S603 calculates, on the extracted
amount of compressed data of all the frames, the average
25 NA and the standard deviation $N\sigma$.

A next step S604 calculates the maximum data
amount by adding the standard deviation $N\sigma$ to the

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1 average NA, and the minimum data amount by subtracting
said standard deviation $N\sigma$ from the average NA.

A next step S605 calculates the minimum and
maximum remaining numbers of recordable frames by
5 dividing the remaining capacity of the memory card
respectively with said maximum and minimum data amounts,
and the sequence then proceeds to a step S607.

On the other hand, in case the next photo-
taking operation is for the first frame, a step S606
10 calculates a value, as a substitute for the remaining
frame number, by dividing the remaining capacity of
the memory card with a predetermined initial value, and
the sequence then proceeds to the step S607.

The step S607 discards the fractional part of
15 the minimum and maximum remaining numbers of recordable
frames, determined in the step S605, or the remaining
frame number determined in the step S606, in order to
obtain integral value(s) for display.

A next step S608 displays thus obtained integral
20 value(s) on the display unit 115, as the remaining
frame number, and the present subroutine is then
terminated.

In said step S604, the maximum and minimum data
amounts may naturally be calculated for example by NA
25 $\pm 2N\sigma$ or $NA \pm 3N\sigma$.

Fig. 17 is a flow chart showing, as a 12th
embodiment, the method for calculating the maximum and

1 minimum data amounts.

The present embodiment calculates, at each phototaking operation, the average A of the data amounts of the already recorded frames and the standard deviation σ thereof, and the latest $A \pm \sigma$ are taken as the maximum and minimum data amounts. The photographer can reset the average A at an arbitrary point, and the average is thereafter calculated anew. Said resetting can be achieved, for example, by two depressions of the selector button 18 within a pre-determined period.

The sequence of the present subroutine will be explained in the following step by step.

At first a step S651 discriminates whether a resetting has been conducted, and the sequence proceeds to a step S658 or S652 respectively if the resetting has been conducted or not.

The step S652 discriminates whether the next phototaking operation is for the 1st frame after the latest resetting. This is because the average calculation requires data of at least one frame. Then the sequence proceeds to a step S653 or S659, respectively if the next phototaking operation is at least for the 2nd frame, or for the 1st frame.

The step S653 counts the number of frames recorded from the latest resetting to the latest phototaking operation. Said counting can be achieved by

1 memorizing the number of recorded frames and adding one,
at each phototaking operation, to the latest count.

A next step S654 extracts the amount of recorded
compressed data, corresponding to thus counted frames.

5 A next step S655 calculates the average A of
the compressed data amounts of the extracted frames
and the standard deviation σ thereof.

A next step S656 calculates the maximum data
amount by adding the standard deviation σ to the
10 average A, and the minimum data amount by subtracting
the standard deviation σ from the average A.

A next step S657 calculates the minimum and
maximum remaining numbers of recordable frames by
dividing the remaining capacity of the memory card
15 respectively with the maximum and minimum data amounts,
and then the sequence proceeds to a step S660.

In case the resetting has been conducted, a
step S658 cancels the counting of recorded frames
conducted in the immediately preceding step S653, and
20 the sequence then proceeds to a step S659.

In case the counting is cancelled or in case
the next phototaking operation is identified for the
1st frame, a step S659 calculates a value, as a
substitute for the remaining frame number, by dividing
25 the remaining capacity of the memory card with a
predetermined initial value.

The sequence from a next step S660 is same as

1 that starting from the step S607 in the 12th embodiment
shown in Fig. 16.

Fig. 18 is a flow chart showing, as a 13th
embodiment, a subroutine for calculating the maximum
5 and minimum data amounts.

In the present embodiment, the method of
calculation of the maximum and minimum values and the
resettable configuration are same as those in the 12th
embodiment. Thus, steps same as those in the flow
10 chart in Fig. 17 are represented by same numbers and
will not be explained, and the following description
will be devoted to steps S670 and S671, which are
different from the 12th embodiment.

The step S671 renews the memory each time the
15 maximum and minimum data amounts are calculated in the
step S656.

In case the counting is cancelled or in case
the next phototaking operation is identified for the
frist frame, the sequence proceeds to the step S670,
20 which calculates values, as substitutes for the
remaining frame numbers, by dividing the remaining
capacity of the memory card with the stored maximum
and minimum data amounts immediately before the
resetting.

25 In the 12th and 13th embodiments, the average
value A may be reset each time the memory card is
inserted into the main body 11 of the camera.

1 Fig. 19 is a flow chart showing, as a 14th
embodiment, a subroutine for determining the maximum
and minimum data amounts.

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